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Radar Interferometric Studies of Comets

Department of Astronomy
University of Illinois
231 Astronomy Building
1002 West Green Street
Urbana, IL 61801

Lewis E. Snyder (PI), University of Illinois
Patrick Palmer (Co-I), University of Chicago
Imke De Pater (Sci Coll), University of California, Berkeley

Strategy

Our objectives are to use radio interferometry to study the composition, velocity distribution, maser excitation, and plasma interactions of cometary gas. In previous studies, we demonstrated that the VLA can be used to make radio images of 18 cm wavelength cometary OH emission with a resolution of $\approx 1'$ which show previously unknown and unexpected small scale structure close to the nucleus. We used similar techniques with the VLA to detect the 6 cm transition of H_2CO in comets Halley, Machholz, and Brorsen-Metcalf. We discovered that the Comet Halley H_2CO emission was produced from an extended source in the coma as well as directly from the nucleus; this was later confirmed by Krankowsky's analysis of the H_2CO channel in the NMS data. The centimeter wavelength detections place important constraints on the partition function and excitation of cometary H_2CO; these constraints are essential for interpreting observations at shorter wavelengths and, in particular, for deriving the correct gas production rate from radiative transfer models.

Two new cometary chemistry programs have been started with radio interferometers. First, the VLA has been used to search for HC_3N emission from Comet Brorsen-Metcalf at 3.3 cm wavelength, and it was demonstrated that for this molecule the VLA can be expected to reach significant levels of sensitivity in many comets. Second, the BIMA millimeter array was used to observe Comet Austin in HCN while our colleagues observed HCN simultaneously with the FCRAO 14-m radio telescope and the Flagstaff 42-inch optical telescope. The primary goal was to map the distribution of cometary HCN, compare the radio data with the simultaneous, high resolution optical CN images, and solve the long-standing problem of whether HCN is the parent molecule of optical CN. The secondary goal was to test the feasibility of detecting the 3 mm continuum emission from comets. Both programs have had a modest amount of success, which demonstrates some important directions for future radio interferometric studies of cometary chemistry.

Publications

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